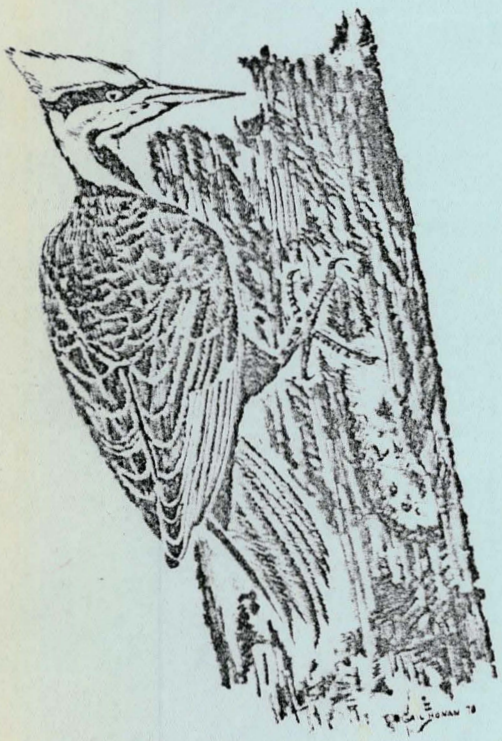

Management Plan for Dead and Defective Trees on the Olympic National Forest

USDA · Forest Service
Pacific Northwest Region
Olympic National Forest

MANAGEMENT PLAN

FOR

DEAD AND DEFECTIVE TREES

ON

THE OLYMPIC NATIONAL FOREST

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I. INTRODUCTION

The Olympic National Forest contains approximately 650,552 acres, of which 593,004 (91%) are currently classified as commercial timber lands. The definition for commercial lands includes land capable of producing 20 cubic feet of wood per acre per year. Dead and defective trees are common components of all naturally formed Forest stands on these commercial acres.

Existing dead and defective trees in naturally formed stands are being eliminated by timber harvesting. Short rotation periods and multiple commercial entries proposed for managed stands will prevent dead and defective tree habitat from forming or persisting in the future. Consequently, populations of species that require dead and defective tree habitat for various needs during all or part of their life cycles will be significantly reduced on the commercial Forest acres. A management program to retain adequate dead and defective tree habitat is necessary to sustain viable populations of these wildlife species.

A great variety of wildlife species use dead and defective trees for nesting, denning, perching, roosting, feeding, and cover. At least 63 wildlife species: 37 birds, 21 mammals, 3 amphibians, and 2 reptiles found on the Olympic, require or are heavily dependent on dead and defective trees during all or part of their lives (Table 1 Section I).

The Region 6 Dead Tree (Snag) Policy, FSM 2630.3, R-6 Supplement 15, dated October, 1977, recognizes the problems and also directs each Forest Supervisor to develop and implement a dead and defective tree management plan. The Forest commitment to manage for self-sustaining wildlife populations is an absolute responsibility. Direction stems from the Multiple Use Sustained Yield Act, the Natural Resources Planning Act, and the Forest Management Practices Act.

II. MANAGEMENT OBJECTIVES

Objectives of the Dead and Defective tree policy are as follows:

1. Maintain self-sustaining (non-threatened) populations of wildlife species that utilize dead and defective habitat within the Olympic National Forest.

2. Maintain the ecological diversity (species types, numbers and distribution) of wildlife species that utilize dead and defective tree habitat throughout the Forest.

A. GUIDELINE INTENT

These guidelines are intended to be viewed as the GENERAL RULE, DIRECTION, or SIDEBOARDS. For every general rule there are exceptions. Adjustments to these guidelines to meet on-the-ground situations will and should occur. There is no substitute for on-the-ground discussion between biologists, sales planners, Timber Staff, and other disciplines to develop alternatives to meet the intent of the Dead and Defective Tree Management Policy. The coordination of wildlife needs and timber production are mandatory for successful attainment of both resource goals. District Biologists are expected to expand, and refine these guidelines.

B. DATA SOURCE

The Biological data and concepts used in the management plan were primarily developed by the U.S. Forest Service and the Pacific Northwest Forest and Range Experiment Station at LaGrande, Oregon. The basic document TIMBER AND WILDLIFE HABITAT RELATIONSHIPS FOR THE BLUE MOUNTAINS OF WASHINGTON AND OREGON has been widely distributed, and the primary precepts are applicable here.

The basic document was further condensed and simplified for guideline application to West Side Forests by an interdisciplinary team of specialists representing fire and fuels management, silviculture, logging systems, landscape architecture, and wildlife management (Appendix I). The draft report of their joint efforts, Guidelines For Managing Dead and Defective Trees on Area 6 Forests, was distributed for review May 14, 1977.

The guidelines and management direction in this Forest Plan include many of the principles and recommendations contained in the Area 6 Draft Plan.

The key papers which contain the data and concepts are cited in Appendix II. Readers seeking additional information should consult the original papers.

III. RESPONSIBILITY AND IMPLEMENTATION

1. RESPONSIBILITY

A. FOREST SUPERVISOR - The responsibility for preparation of a Forest-wide Dead and Defective Tree Habitat Management Plan rests with the Forest Supervisor. Approval of this Plan by the Forest Supervisor commits each District to implement the Forest Guidelines in compliance with national and regional policy.

B. DISTRICT RANGER - Each District Ranger is responsible for carrying out the Forest Dead and Defective Tree Management Plan for his District.

C. DISTRICT BIOLOGISTS - RESOURCE ASSISTANT - Each District biologist will refine appropriate portion of the management plan to meet unique situations on the District. This refinement will become an addendum to the Forest Plan after approval by the Forest Supervisor.

2. COORDINATION

Successful implementation of the Dead and Defective Tree Management Plan requires each District biologist and/or Resource Assistant to coordinate on-site management prescriptions with interdisciplinary team members on timber sales. Conflicts associated with safety, logging systems, and silviculture techniques must be discussed. Trade-offs and alternative prescriptions to retain sufficient dead/defective and down tree habitat to support the required 40 percent minimum population of wildlife species must be explored.

3. COSTS

Implementation of the plan may involve additional time commitments and manpower costs not normally related to timber sale planning or reconnaissance by an interdisciplinary team. Most dead and defective tree habitat retention or improvement activities can be accomplished through the Stand Area Improvement Plan (SAI) for a timber sale. Sale costs not related to the SAI plan, and associated with the necessity to select and identify individual live trees for protection or to compensate for adequate habitat needs in timber sale areas and road right-of-way, and future snag development during the pre-commercial and commercial thinning entries, need to be reflected in each District budget.

The additional cost in trade-offs for retention of dead and defective trees on each District should be reflected in declines in timber yields. These trade-offs should be addressed in the Environmental Analysis Report (EAR) for the timber sale.

4. ENVIRONMENTAL IMPACTS

The Environmental Analysis Report (EAR) prepared for timber sales and other projects provides a vehicle to identify:

A. The adverse effects caused by removal of dead and defective trees.

B. The mitigating effects provided by the dead and defective tree habitat management plan.

C. A description of dead and defective tree conditions in Streamside Management Units, riparian zones, or other locations.

D. Monetary trade-offs (cost) for retention of dead and defective trees.

5. TRAINING

Long-range successful management will require training for District sales planners and other District personnel to recognize desirable habitat needs relative to existing snags, types, numbers, and retention of cull and unmerchantable live trees for future snag development.

The Assistant Staff Wildlife Biologist will conduct an annual training session on Snag Management. This could best be done with individual sessions at the District level.

6. ACCOUNTABILITY

Compliance with the National, Regional and Forest direction regarding snag management will be evaluated as part of the annual forest management review system.

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GUIDELINE: IN STANDS CONTAINING A MIXTURE OF DECIDUOUS TREES AND CONIFEROUS TREES, SELECT A MAJORITY OF CONIFERS FOR RETENTION.

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GUIDELINE: SELECT TREES FOR RETENTION THAT MEET OR EXCEED THE NESTING REQUIREMENTS OF EXCAVATORS.

C. Dead Tree Condition

GUIDELINE: SELECT AN EQUAL PROPORTION OF HARD AND SOFT DEAD TREES FOR RETENTION.

D. Live Tree Condition

GUIDELINE: SELECT LIVE TREES WITH DEFECTS FOR RETENTION. IN THE ABSENCE OF ADEQUATE NUMBERS OF DEFECTIVE TREES, LEAVE SOUND TREES.

E. Trees Currently Used

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SPECIFIC MANAGEMENT DIRECTION: PRIORITY AREA SELECTION FOR MANAGEMENT OF DEAD AND DEFECTIVE TREES TO ACHIEVE THE QUANTITY NECESSARY FOR DESIRED POPULATION LEVELS OF EXCAVATORS IS LISTED BELOW:

A. Manage for 100 per cent of the maximum population in areas allocated for older Forest Management and other areas under extended timber rotation. Also achieve this level in areas designated for other than timber harvest (e.g. wilderness study and scenic - research areas).

B. Manage at least 80 per cent of the maximum population within 3 chains of water bodies (e.g. lakes and streams).

C. Manage for at least 60 per cent of the maximum population within 3 chains of meadows one acre or larger.

D. Manage for 40 per cent of the maximum population on applicable other commercial forest lands as necessary to meet or exceed the 40% land base level.

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GUIDELINE: MANAGE FOR TREES WITH DEFECTS BETWEEN BOUNDARIES OF CUTTING UNITS ON THE LOSER ONE-HALF OF THE SLOPE.

GUIDELINE: MANAGE FOR SELECTED DEAD OR DEFECTIVE TREES THAT ARE MORE THAN 50 FEET SLOPE DISTANCE FROM THE EDGE OF THE CLEARCUT UNIT AND HAVE LITTLE PROBABILITY OF FALLING INTO THE UNIT OR CATCHING FIRE WHEN THE SLASH IS BURNED.

B. Partial Cuts (Commercial Thinnings, Salvage, Shelterwood).

GUIDELINE: MANAGE FOR AN EVEN DISTRIBUTION OF DEAD AND DFECTIVE TREES IN MOST AREAS WITHIN PARTIAL CUTS.

C. Adjacent to Water Courses, Bodies of Water, or Forest Openings

GUIDELINE: MANAGE FOR AN ABUNDANCE OF DEAD AND DEFECTIVE TREES WITHIN FLOOD PLAINS OF STREAMS AND WITHIN 3 CHAINS FROM LAKES, PONDS, MARSHES, MEADOWS, AND GRASSLANDS.

D. Roads

GUIDELINE: MANAGE FOR ANY DEAD OR DEFECTIVE LIVE TREE WITHIN 200 FEET SLOPE DISTANCE FROM A ROAD IF IT HAS LITTLE PROBABILITY OF FALLING INTO THE ROAD.

E. Helicopter Hoverfills

GUIDELINE: ALLOCATE SMALL LAKES OR PONDS BETWEEN WILDLIFE AND HOVERFILL SITES.

GUIDELINE: MANAGE FOR ANY DEAD TREE THAT DOES NOT EXTEND ABOVE THE TREE CANOPY WITHIN THE PRIMARY FLIGHT PATH TO AND FROM HOVERFILLS AT LARGE LAKES OR PONDS.

F. Firebreaks

GUIDELINE: MANAGE FOR ANY DEAD TREE THAT IS 150 FEET FROM THE FIREBREAK CORRIDOR AND IS UNDER THE CANOPY, OR ABOVE THE TREE CANOPY BUT NOT ABOVE GROUND LEVEL OF THE CORRIDOR.

APPENDIX II - DEAD AND DOWN TREES

Section 1. Number, Size and Distribution

GUIDELINE: AT A MINIMUM, MANAGE FOR TWO DEAD AND DOWN TREES WITH A DBH OF 12" OR GREATER AND CONTAINING 40 OR MORE CUBIC FEET PER ACRE. NOTE: THE TREE SHOULD BE LOCATED ON THE SAME ACRES AS STANDING DEAD AND DEFECTIVE TREE HABITAT AREAS.

Section 2. Kinds of Dead and Down Trees

GUIDELINE: IN STANDS DOMINATED BY CONIFERS, SELECT CONIFERS FOR RETENTION.

GUIDELINE: IN STANDS DOMINATED BY DECIDUOUS TREES, SELECT SOME CONIFERS (IF PRESENT) AND A MAJORITY OF DECIDUOUS TREES FOR RETENTION.

APPENDIX I

STANDING DEAD AND DEFECTIVE TREES

Section 1. KINDS OF WILDLIFE SPECIES TO MANAGE

Standing dead or defective trees provide nest sites for all cavity nesting birds and most cavity nesting mammals. They serve as hunting sites for birds of prey, display perches for courting song birds, and feeding sites for most insectivorous birds, especially woodpeckers.

Three groups of wildlife use dead and defective trees (Table 1):

EXCAVATORS - Excavate nesting and roosting cavities in dead wood.

SECONDARY CAVITY NESTERS - Use cavities abandoned by excavators or natural cavities in dead wood.

OPPORTUNE USERS - A variety of species that use dead or defective trees for perching, nesting, cover, feeding, and courtship.

GENERALLY, IF THE DEAD OR DEFECTIVE TREES REQUIRED BY THE EXCAVATOR SPECIES FOR NESTING, ROOSTING, AND FEEDING ARE PROVIDED, THE REQUIREMENTS OF MOST SPECIES IN THE OTHER TWO GROUPS WILL ALSO BE PROVIDED.

GUIDELINE: MANAGE STANDING DEAD OR DEFECTIVE TREES FOR EXCAVATOR SPECIES.

Table 1. Wildlife species on the Olympic National Forest that require or are heavily dependent on dead or defective trees.

SPECIES	
EXCAVATORS*	SECONDARY CAVITY USERS CONT.
Pileated woodpecker	Starling
Common flicker	American kestrel
Lewis woodpecker	Chickaree
Northern 3-toed woodpecker	Northern flying squirrel
Black-backed, 3-toed woodpecker	Marten
Yellow-bellied sapsucker	Bushy-tailed woodrat
Hairy woodpecker	Deer mouse
Downy woodpecker	Big brown bat
	Little brown myotis
SECONDARY CAVITY USERS**	California myotis
	Yuma myotis
White-breasted nuthatch	Long-eared myotis
Red-breasted nuthatch	Long-legged myotis
Wood duck	Keen's brown bat
Hooded merganser	Silver-haired bat
Common goldeneye duck	Yellow-pine chipmunk
Barrow's goldeneye duck	Short-tailed weasel
Harlequin duck	Long-tailed weasel
Bufflehead duck	Oppossum
Common merganser	Fisher
Spotted owl	Raccoon
Saw-whet owl	Spotted skunk
Screech owl	
Barn owl	VARIETY OF USES***
Vaux's swift	
Winter wren	Bald eagle 2/
House wren	Red-tailed hawk 2/
Tree swallow	Black bear 3/
Violet-green swallow	Ruffed grouse 4/
Western bluebird	Western red-backed salamander 3/
Mountain bluebird	Pacific gaint salamander 3/
Black-capped chickadee	Northwestern salamander 3/
Chestnut-backed chickadee	Northern alligator lizard 3/
Brown creeper	Northwestern garter snake 5/
House sparrow	

* Excavates own nest in dead/defective trees.
** Uses cavities created by excavator for nesting or denning.
*** Partial checklist, species use dead/defective trees for 8.
1/ Nesting platforms -- standing trees.
2/ Hunting perches -- standing trees.
3/ Feeding, hibernation sites -- down trees.
4/ Courtship (Drumming logs) -- down trees.
5/ Escape cover -- down trees.

Section 2. MANAGE FOR SELF-SUSTAINING POPULATIONS OF EXCAVATORS

The management of dead and defective trees in numbers, size, and distribution is needed to provide self-sustaining populations of excavators. A population of a species must be large enough to survive natural factors such as predation, disease, competition and catastrophic events. Under Natural conditions, factors such as disease, predation, and competition seldom allow populations of excavators to reach maximum densities. Conversely, natural Forest stands are seldom without some excavators. The population size that insures survival over long periods of time is called a self-sustaining population.

The number of pairs of a species in an area is directly related to the number of suitable nesting trees; the more nesting trees, the more nesting pairs. The limitation on population density in an area where nesting trees are abundant is controlled by territorial boundaries. Each species will defend the nest and its surrounding territory from others of the SAME SPECIES within the limits for that particular species. Territorial boundaries differ among species and thus a variety of species will occupy or overlap a particular vegetative habitat zone. The different territorial ranges of excavator species on the Forest are shown in Table 2.

GUIDELINE: AT A MINIMUM, MANAGE FOR A SELF-SUSTAINING POPULATION -- 40 PER CENT OF THE MAXIMUM POPULATION.

TABLE 2

TERRITORY SIZES, MAXIMUM POPULATIONS AND SELF-SUSTAINING POPULATION SIZES OF PRIMARY EXCAVATORS ON THE OLYMPIC NATIONAL FOREST

SPECIES	TERRITORY SIZE(ACRES)	POPULATION SIZES(PAIRS/SQ MI.) MAXIMUM*	SELF-SUSTAINING**
Pileated Woodpecker	300	2	1
Common Flicker	40	16	6
Lewis Woodpecker	15	43	17
Black-backed-3-toed Woodpecker	75	9	4
Northern-3-toed Woodpecker	75	9	4
Yellow-bellied Sapsucker	10	64	26
Hairy Woodpecker	25	26	10
Downy Woodpecker	10	64	26

* Maximum Number of Pairs = 640 acres (1 Sq. Mile) ÷ Territory size.
** Self-sustaining Population = Maximum Number of Pairs X .40.

Section 3. THE VEGETATIVE ZONES TO USE IN MANAGEMENT

The major unit of plant diversity is the vegetative zone. There are five major vegetative zones on the Olympic based on major tree species. Each vegetative zone supports a different combination of animals dependent on stand condition including dead and/or defective trees.

Excavator species respond to different vegetative zones (Table 3). Some species' needs are provided in most zones. Other species' requirements are only met in a few vegetative zones. It is quite likely that many or most needs are only met within certain vegetative groupings, plant communities, within these major vegetative zones. A comparison might be between a Douglas Fir - Rhododendron - Salal community and a Douglas Fir - White Fir - Ocean Spray community. To maintain the ecological interrelationships in each vegetative zone, it becomes necessary to manage for excavators by vegetative zone.

GUIDELINE: MANAGE FOR EXCAVATORS BY VEGETATIVE ZONE.

TABLE 3

DISTRIBUTION OF EXCAVATORS BY VEGETATIVE ZONE

	OCCURRENCE BY VEGETATIVE ZONE				
EXCAVATOR	TRUE FIR	MIXED CONIFER	DOUGLAS FIR	HEMLOCK	ALDER COTTONWOOD
Pileated Woodpecker	X	X	X		
Common Flicker	X	X	X	X	X
Black-backed-3-toed Woodpecker	X	X			
Northern-3-toed Woodpecker	X	X			
Yellow-bellied Sapsucker		X	X	X	X
Hairy Woodpecker	X	X	X	X	
Downy Woodpecker		X	X	X	X
Lewis Woodpecker		X	X	X	X

Section 4. KINDS OF DEAD AND DEFECTIVE TREES TO MANAGE

This section discusses the types and sizes of dead and defective trees required to sustain a variety of excavator species. It involves the management of habitat associations which overlap for specific species, yet provides variety in tree size and types of vegetation for diversity throughout the Forest.

A. TREE SPECIES (LIVE OR DEAD): Subclimax or climax stands of conifers dominate forests in western Oregon and Washington. Consequently, conifers are the most common dead or defective trees present and receive the greatest use by wildlife. Some areas are dominated by seral stands of deciduous trees or mixtures of conifers and deciduous trees. On wet sites or sites receiving continuous disturbance, deciduous trees may be a climax or subclimax species. Most species of conifer, when dead, remain standing longer than dead deciduous trees. Dead conifers are available to excavators for long periods of time.

GUIDELINE: IN STANDS DOMINATED BY CONIFERS, SELECT CONIFERS FOR RETENTION.

GUIDELINE: IN STANDS DOMINATED BY DECIDUOUS TREES, SELECT SOME CONIFERS (IF PRESENT) AND A MAJORITY OF DECIDUOUS TREES FOR RETENTION.

GUIDELINE: IN STANDS CONTAINING A MIXTURE OF DECIDUOUS TREES AND CONIFEROUS TREES, SELECT A MAJORITY OF CONIFERS FOR RETENTION.

B. TREE SIZE: Each species of excavator has a unique set of requirements for the size of the tree it needs for nesting (Table 4). Trees that meet the nesting needs of excavators with the most exacting size requirements are expected to meet the requirements of the other excavators. In addition, the large diameter classes are preferred by most species. AS A GENERAL RULE, THE LARGER THE TREE, THE LONGER IT WILL STAND, THE LONGER IT WILL BE USED, AND THE MORE SPECIES WILL USE IT.

GUIDELINE: SELECT TREES FOR RETENTION THAT MEET OR EXCEED THE NESTING SIZE REQUIREMENTS OF EXCAVATOR.

TABLE 4

MINIMUM SIZE REQUIREMENTS OF EXCAVATORS FOR NESTING TREES

EXCAVATOR	TREE SIZE	
	DIAMETER(IN.)**	HEIGHT(FT.)***
Pileated Woodpecker	20	31
Common Flicker	12	6
Lewis Woodpecker	12	30
Northern-3-toed Woodpecker	12	15
Black-backed-3-toed Woodpecker	12	6
Hairy Woodpecker	10	15
Yellow-bellied Sapsucker	10	15
Downy Woodpecker	6	-

** Minimum Tree DBH required for cavity
*** Minimum height of nest cavities

C. DEAD TREE CONDITION. Wildlife species depend on both hard and soft snags. The pileated and hairy woodpeckers are capable of excavating cavities in hard wood. The Lewis woodpecker requires soft wood. Much of the feeding activity of all woodpeckers occurs in soft wood. Soft snags evolve from hard snags.

GUIDELINE: SELECT AN EQUAL PROPORTION OF HARD AND SOFT DEAD TREES FOR RETENTION.

D. LIVE TREE CONDITION. Live trees with defects, external or internal rot, broken tops. . ., provide excavators with immediate opportunities for nesting and feeding. Generally, these trees have low merchantability.

GUIDELINE: SELECT LIVE TREES WITH DEFECTS FOR RETENTION. IN THE ABSENCE OF ADEQUATE NUMBERS OF DEFECTIVE TREES, LEAVE SOUND TREES.

E. TREES CURRENTLY USED. A cavity or den in use is the best indicator that a tree is suitable for excavators or secondary cavity nesters. At a minimum, it will provide feeding or nesting opportunities for secondary cavity users.

GUIDELINE: A TREE WITH AN ACTIVE CAVITY OR DEN SHOULD BE SELECTED FOR RETENTION OVER OTHER TREES.

F. ATTRITION OF DEAD TREES (SNAGS). The length of time a dead or defective tree will remain standing is dependent on a variety of factors. These factors include type and soundness of the tree, diameter, height, exposure, slope, soil depth, root structure, and angle of lean. These factors contribute to the "Life" expectancy of dead and defective trees. Generally, the larger the tree diameter, the longer "Life" span of a snag.

GUIDELINE: SELECT THE LARGER DIAMETER SNAGS AND DEFECTIVE TREES.

Section 5. NUMBERS OF DEAD AND DEFECTIVE TREES REQUIRED TO MAINTAIN SELF-SUSTAINING POPULATIONS OF EXCAVATOR SPECIES.

Each species requires a certain number of trees for nesting. Some excavators require more than one dead or defective tree per year, i.e., one for nesting and one or more for roosting (Table 5). Usually, the cavities are in different trees. FOR EACH CAVITY IN USE, THERE ARE ABOUT 15 ADDITIONAL DEAD OR DEFECTIVE TREES (WITHOUT CAVITIES) WITHIN THE TERRITORIAL ZONE OF EXCAVATORS. These trees are needed for feeding, courtship, and FUTURE nesting or roosting sites.

The number of dead and defective trees required for a species is a critical habitat requirement. The number of dead and defective trees required to support a self-sustaining population can be calculated for and area:

Example: HAIRY WOODPECKER (Data from Table 5).

STEP I - Calculate the maximum number of nesting pairs that can nest on an area by dividing the area by the territory size.

$$\frac{\text{Acres/sq. mile (640)}}{\text{Hairy woodpecker territory size (25 acres)}} = \text{26 hairy woodpecker pairs/sq. mile}$$

STEP II - Calculate the number of dead/defective trees required to sustain the maximum number of nesting pairs per square mile.

(26) Maximum No. nesting pairs/sq. mi.	X	(1) No. cavities required/nesting pair/year	X	(15) No. snags without cavities /pair	=	(390) No. snags required for maximum No. nesting pairs/sq. mile of hairy woodpeckers

STEP III - To find the number of dead/defective trees required to maintain a self-sustaining population, multiply the number of snags needed by the maximum number of nesting pairs by .40 (40 per cent).

(390) No. snags required for maximum No. nesting pairs/sq. mile	X	(.40) self-sustaining population size as a percentage of maximum	=	(156) No. snags required for self-sustaining population/sq. mile of hairy woodpeckers.

Table 5 provides estimates of the number of dead/defective trees required to support various population levels of excavators.

GUIDELINE: MANAGE DEAD AND DEFECTIVE TREES FOR THE QUANTITY NECESSARY TO SUSTAIN AT LEAST A MINIMUM SELF-SUSTAINING POPULATION OF EACH EXCAVATOR SPECIES.

SPECIFIC MANAGEMENT DIRECTION: Priority area selection for management of dead and defective trees to achieve the quantity necessary for desired population levels of excavators is listed below:

A. Manage for 100 per cent of the maximum population in areas allocated for older Forest Management and other areas under extended timber rotation. Also achieve this level in areas designated for other than timber harvest (e.g. wilderness study and scenic-research areas).

B. Manage for at least 80 per cent of the maximum population within 3 chains of water bodies (e.g. lakes and streams).

C. Manage for at least 60 per cent of the maximum population within 3 chains of meadows one acre or larger.

D. Manage for 40 per cent of the maximum population on applicable other commercial Forest lands as necessary to meet or exceed the 40 per cent land base level.

TABLE 5. NUMBERS OF DEAD TREES PER SQUARE MILE REQUIRED TO MAINTAIN VARIOUS POPULATION LEVELS OF PRIMARY EXCAVATORS

SPECIES	CAVITIES/* PAIR	TERRITORY SIZE (ACRES)	NO. DEAD TREES/SQ. MILE (NO. PAIRS/SQ. MILE)				
			100%**	80%	60%	40%***	20%
Pileated Woodpecker	3	300	90(2)	72(1.6)	54(1)	36(.8)	18(.4)
Common Flicker	1	40	240(16)	195(13)	150(10)	90(6)	45(3)
Lewis Woodpecker	1	15	645(43)	516(34)	387(26)	258(17)	129(9)
Black-backed-3-toed Woodpecker	3	75	405(9)	315(7)	225(5)	180(4)	90(2)
Northern-3-toed Woodpecker	3	75	405(9)	315(7)	225(5)	180(4)	90(2)
Yellow-bellied Sapsucker	1	10	960(64)	768(51)	576(38)	384(26)	192(13)
Hairy Woodpecker	1	25	390(26)	312(21)	234(16)	156(10)	78(5)
Downy Woodpecker	2	10	1,920(64)	1,530(51)	1,152(38)	768(26)	384(13)

* Each pair requires 15 additional dead or defective trees per cavity in its territory.
** Maximum theoretical population.
*** Population size needed to maintain self-sustaining population over time.

Section 6. SUMMARY OF QUANTITY AND SIZE OF SNAGS REQUIRED FOR VARIOUS POPULATION LEVELS - HABITAT OVERLAP CALCULATED

It is important to note that if the habitat requirements of one species of excavators are met, the requirements of another excavator species also may be met to some degree. Therefore, it is not necessary to manage for the cumulative number of dead/defective trees required in an area.

Example (Data from Table 5).

The hairy and down woodpeckers basically require the same kinds of trees. Any tree provided the hairy woodpecker could also be used by the downy, because it meets or exceeds the downy's size requirement.

Hairy woodpecker --10" x 15' minimum tree size used
Downy woodpecker -- 6" x 15' minimum tree size used

However, each species requires a different number of trees to maintain a self-sustaining population (40 per cent of maximum population).

Hairy woodpecker -- 156 trees/square mile
Downy woodpecker -- 768 trees/square mile

Because different species do not compete territorially, the downy woodpecker will use the same trees that the hairy woodpecker uses.

Therefore, the same 156 trees needed by the hairy woodpecker will provide 20 per cent (156÷768) of the trees required by downy woodpeckers.

A summary, by Vegetative Zone, of Snag requirements for those excavator species known to inhabitat the Olympic National Forest is given below (Tables 6.1, 7.1, 8.1, 9.1, and 10.1). Calculations have been made for habitat overlap amoung species and are reflected in this summary (Tables 6.2, 7.2, 8.2, 9.2, and 10.2).

TABLE 6

TRUE FIR VEGETATIVE ZONE

1. HARD SNAG REQUIREMENTS FOR WOODPECKERS

MINIMUM SNAG DBH (INCHES)	MINIMUM NEST HEIGHT (FEET)	SPECIES	SNAGS REQUIRED PER 100 ACRES TO SUPPORT VARIOUS PERCENTAGES OF POPULATION MAXIMUM							
			100	90	80	70	60	50	40	30
12	6	Common Flicker	38	34	30	26	23	19	15	11
12	30	Lewis Woodpecker	100	90	80	70	60	50	40	30
12	15	Northern-3-toed Woodpecker	60	54	48	42	36	30	24	18
12	6	Black-backed-3-toed Woodpecker	60	54	48	42	36	30	24	18
10	15	Hairy Woodpecker	61	55	49	43	37	31	24	18

2. MAXIMUM SUBSTITUTION OF LARGER FOR SMALLER SNAGS. ASSUMES SIMILAR POPULATION LEVELS FOR ALL SPECIES.

MINIMUM SNAG DBH (INCHES)	SNAGS REQUIRED PER 100 ACRES BY DBH CLASS TO SUPPORT VARIOUS PERCENTAGES OF MAXIMUM POTENTIAL POPULATIONS							
	100	90	80	70	60	50	40	30
12	100	90	80	70	60	50	40	30
10	0	0	0	0	0	0	0	0
MIN. TOTAL SNAGS	100	90	80	70	60	50	40	30

TABLE 7

MIXED CONIFER VEGETATIVE ZONE

1. HARD SNAG REQUIREMENTS FOR WOODPECKERS

MINIMUM SNAG DBH (INCHES)	MINIMUM NEST HEIGHT (FEET)	SPECIES	SNAGS REQUIRED PER 100 ACRES TO SUPPORT VARIOUS PERCENTAGES OF POPULATION MAXIMUM							
			100	90	80	70	60	50	40	30
20	31	Pileated Woodpecker	15	14	12	11	9	8	6	5
12	6	Common Flicker	38	34	30	26	23	19	15	11
12	30	Lewis Woodpecker	100	90	80	70	60	50	40	30
12	15	Northern-3-toed Woodpecker	60	54	48	42	36	30	24	18
12	6	Black-backed-3-toed Woodpecker	60	54	48	42	36	30	24	18
10	15	Hairy Woodpecker	61	55	49	43	37	31	24	18
10	15	Yellow-bellied Sapsucker	150	135	120	105	90	75	60	45
6	-	Downy Woodpecker	300	270	240	210	180	150	120	90

2. MAXIMUM SUBSTITUTION OF LARGER FOR SMALLER SNAGS. ASSUMES SIMILAR POPULATION LEVELS FOR ALL SPECIES.

MINIMUM SNAG DBH (INCHES)	SNAGS REQUIRED PER 100 ACRES BY DBH CLASS TO SUPPORT VARIOUS PERCENTAGES OF MAXIMUM POTENTIAL POPULATIONS							
	100	90	80	70	60	50	40	30
20	15	14	12	11	9	8	6	5
12	85	76	68	59	51	42	34	25
10	50	45	40	35	30	25	20	15
6	150	135	120	105	90	75	60	45
MIN. TOTAL SNAGS	300	270	240	210	180	150	120	90

TABLE 8

DOUGLAS FIR VEGETATIVE ZONE

1. HARD SNAG REQUIREMENTS FOR WOODPECKERS

MINIMUM SNAG DBH (INCHES)	MINIMUM NEST HEIGHT (FEET)	SPECIES	SNAGS REQUIRED PER 100 ACRES TO SUPPORT VARIOUS PERCENTAGES OF POPULATION MAXIMUM							
			100	90	80	70	60	50	40	30
20	31	Pileated Woodpecker	15	14	12	11	9	8	6	5
12	6	Common Flicker	38	34	30	26	23	19	15	11
12	30	Lewis Woodpecker	100	90	80	70	60	50	40	30
10	15	Hairy Woodpecker	61	55	49	43	37	31	24	18
10	15	Yellow-bellied Sapsucker	150	135	120	105	90	75	60	45
6	-	Downy Woodpecker	300	270	240	210	180	150	120	90

2. MAXIMUM SUBSTITUTION OF LARGER FOR SMALLER SNAGS. ASSUMES SIMILAR POPULATION LEVELS FOR ALL SPECIES.

MINIMUM SNAG DBH (INCHES)	SNAGS REQUIRED PER 100 ACRES BY DBH CLASS TO SUPPORT VARIOUS PERCENTAGES OF MAXIMUM POTENTIAL POPULATIONS							
	100	90	80	70	60	50	40	30
20	15	14	12	11	9	8	6	5
12	85	76	68	59	51	42	34	25
10	50	45	40	35	30	25	20	15
6	150	135	120	105	90	75	60	45
MIN. TOTAL SNAGS	300	270	240	210	180	150	120	90

TABLE 9

WESTERN HEMLOCK VEGETATIVE ZONE

1. HARD SNAG REQUIREMENTS FOR WOODPECKERS

MINIMUM SNAG DBH (INCHES)	MINIMUM NEST HEIGHT (FEET)	SPECIES	SNAGS REQUIRED PER 100 ACRES TO SUPPORT VARIOUS PERCENTAGES OF POPULATION MAXIMUM							
			100	90	80	70	60	50	40	30
12	30	Lewis Woodpecker	100	90	80	70	60	50	40	30
12	6	Common Flicker	38	34	30	26	23	19	15	11
10	15	Hairy Woodpecker	61	55	49	43	37	31	24	18
10	15	Yellow-bellied Sapsucker	150	135	120	105	90	75	60	45
6	-	Downy Woodpecker	300	270	240	210	180	150	120	90

2. MAXIMUM SUBSTITUTION OF LARGER FOR SMALLER SNAGS. ASSUMES SIMILAR POPULATION LEVELS FOR ALL SPECIES.

MINIMUM SNAG DBH (INCHES)	SNAGS REQUIRED PER 100 ACRES BY DBH CLASS TO SUPPORT VARIOUS PERCENTAGES OF MAXIMUM POTENTIAL POPULATIONS							
	100	90	80	70	60	50	40	30
12	100	90	80	70	60	50	40	30
10	50	45	40	35	30	25	20	15
6	150	135	120	105	90	75	60	45
MIN. TOTAL SNAGS	300	270	240	210	180	150	120	90

TABLE 10

ALDER/COTTONWOOD (RIPARIAN) VEGETATIVE ZONE

1. HARD SNAG REQUIREMENTS FOR WOODPECKERS

MINIMUM SNAG DBH (INCHES)	MINIMUM NEST HEIGHT (FEET)	SPECIES	SNAGS REQUIRED PER 100 ACRES TO SUPPORT VARIOUS PERCENTAGES OF POPULATION MAXIMUM							
			100	90	80	70	60	50	40	30
12	30	Lewis Woodpecker	100	90	80	70	60	50	40	30
12	6	Common Flicker	38	34	30	26	23	19	15	11
10	15	Yellow-bellied Sapsucker	150	135	120	105	90	75	60	45
6	-	Downy Woodpecker	300	270	240	210	180	150	120	90

2. MAXIMUM SUBSTITUTION OF LARGER FOR SMALLER SNAGS. ASSUMES SIMILAR POPULATION LEVELS FOR ALL SPECIES.

MINIMUM SNAG DBH (INCHES)	SNAGS REQUIRED PER 100 ACRES BY DBH CLASS TO SUPPORT VARIOUS PERCENTAGES OF MAXIMUM POTENTIAL POPULATIONS							
	100	90	80	70	60	50	40	30
12	100	90	80	70	60	50	40	30
10	50	45	40	35	30	25	20	15
6	150	135	120	105	90	75	60	45
MIN. TOTAL SNAGS	300	270	240	210	180	150	120	90

Section 7. THE MINIMUM AREA NEEDED TO MAINTAIN SELF-SUSTAINING POPULATIONS OF EXCAVATORS

A MINIMUM self-sustaining population can be retained throughout the Forest by managing for various combinations of acres and population sizes as indicated in Table 11 and Figure 1. For example, management extremes of 100 per cent of the commercial Forest land base at 40 per cent population level, or 40 per cent of the commercial Forest land base at the 100 per cent population level, result in a theoretical minimum self-sustaining population of 40 per cent. It is important to note that while the percentage results are the same, they represent different biological conditions because of differences in distribution.

At a minimum, 40 per cent of the land is needed to support a self-sustaining population. A series of options is provided to the manager using different combinations of acres and population levels (Table 11 and Figure 1).

GUIDELINE: MANAGE FOR A COMBINATION OF ACRES AND POPULATION LEVELS THAT PROVIDE AT LEAST 40 PER CENT OF THE MAXIMUM POPULATION LEVEL.

Most commercial timber lands on the Forest will be managed with a standard set of practices, rotation periods, logging systems, and commercial thinning. However, some commercial lands identified by land management or timber management planning, e. g., roadless areas, stands managed for the older Forest community, or stands on steep slopes with unstable soils, will require special timber management practices. These stands may be on extended rotations, or receive no commercial thinnings, only the final harvest cut. Conditions in these stands will approximate natural stands and dead and defective trees should be common. These stands may be counted as part of the commercial lands being managed for dead and defective trees.

Other commercial Forest lands may have been officially withdrawn from timber harvest. These lands are classified as wilderness, research natural areas, scenic-research areas . . . or have similar designations. Dead and defective trees will be common in these stands. These stands will be counted as part of the commercial lands on the Forest being managed for dead and defective trees. Note, only the forested acres may be counted.

GUIDELINE: COUNT FOREST STANDS UNDER SPECIAL TIMBER MANAGEMENT THAT HAVE AN ABUNDANCE OF DEAD-DEFECTIVE TREES, AND THOSE OFFICIALLY WITHDRAWN FROM HARVEST, AS PART OF THE ACRES OF COMMERCIAL LANDS BEING MANAGED FOR DEAD AND DEFECTIVE TREES.

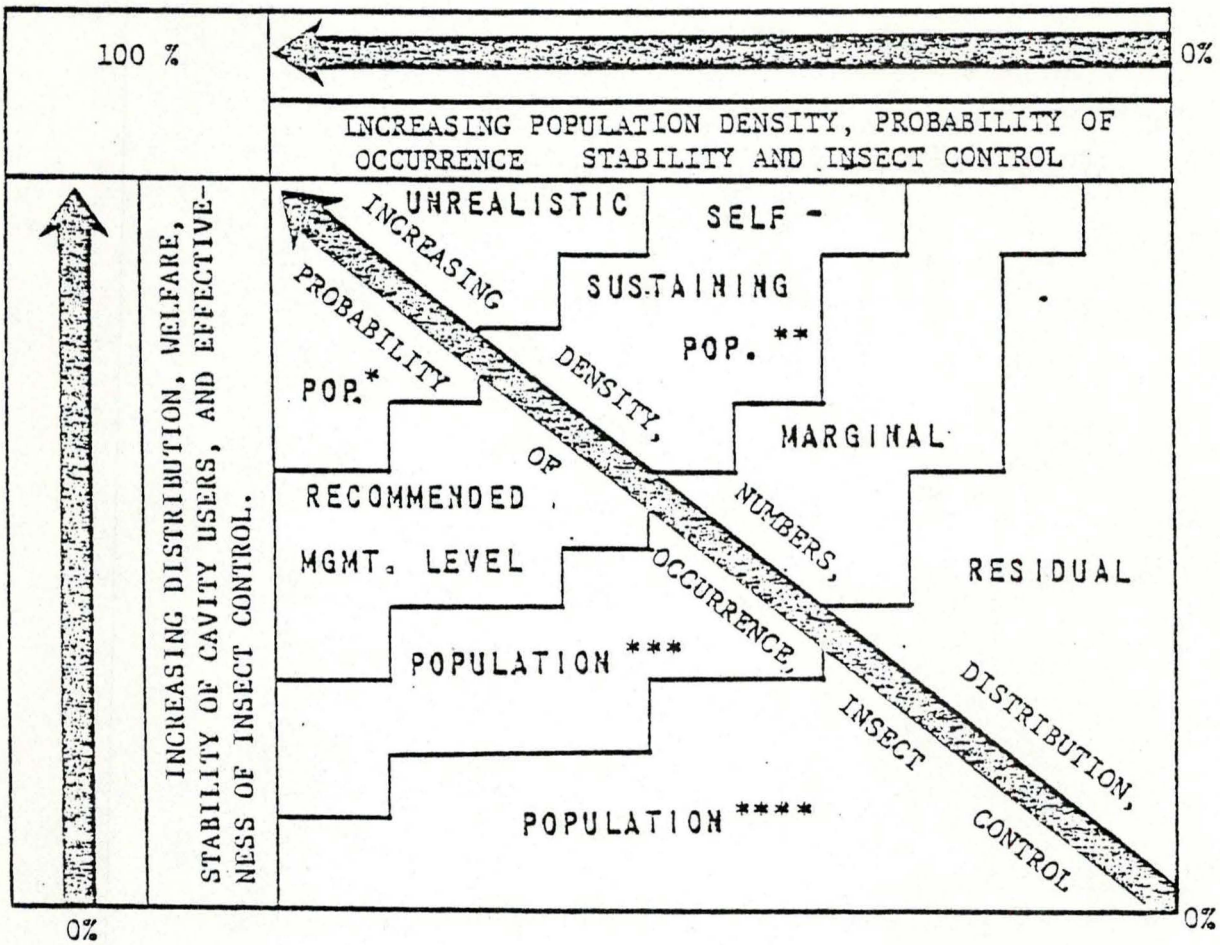
TABLE 11

PERCENT OF MAXIMUM POPULATION OBTAINED BY MANAGING VARIOUS COMBINATIONS OF ACRES AND POPULATION LEVELS

PERCENT OF FORESTED ACRES IN SNAG MGT.	POPULATION LEVEL SELECTED FOR MANAGEMENT									
	100	90	80	70	60	50	40	30	20	10
100	100	90	80	70	60	50	40	30	20	10
90	90	81	72	63	54	45	36	27	18	9
80	80	72	64	56	48	40	32	24	16	8
70	70	63	56	49	42	35	28	21	14	7
60	60	54	48	42	36	30	24	18	12	6
50	50	45	40	35	30	25	20	15	10	5
40	40	36	32	28	24	20	16	12	8	4
30	30	27	24	21	18	15	12	9	6	3
20	20	18	16	14	12	10	8	6	4	2
10	10	9	8	7	6	5	4	3	2	1

FIGURE 1

EXPLANATION OF TABLE 11



* SELF-SUSTAINING POPULATION - snag management above the 60% level is probably impractical as other limiting factors on snag-dependent species become active.

** SELF-SUSTAINING POPULATION - snag management between the 40 and 60% level will give a high probability of retaining self-sustaining populations of snag-dependent species.

*** MARGINAL POPULATIONS - snag management between the 40 and 20% level will give a high probability of eliminating species from (1) vegetative zones, (2) a majority of the land base, and (3) certain species from the entire land base.

**** RESIDUAL POPULATIONS - snag management at this level would result in eliminating nearly all excavators and secondary cavity nester from the entire land base over time.

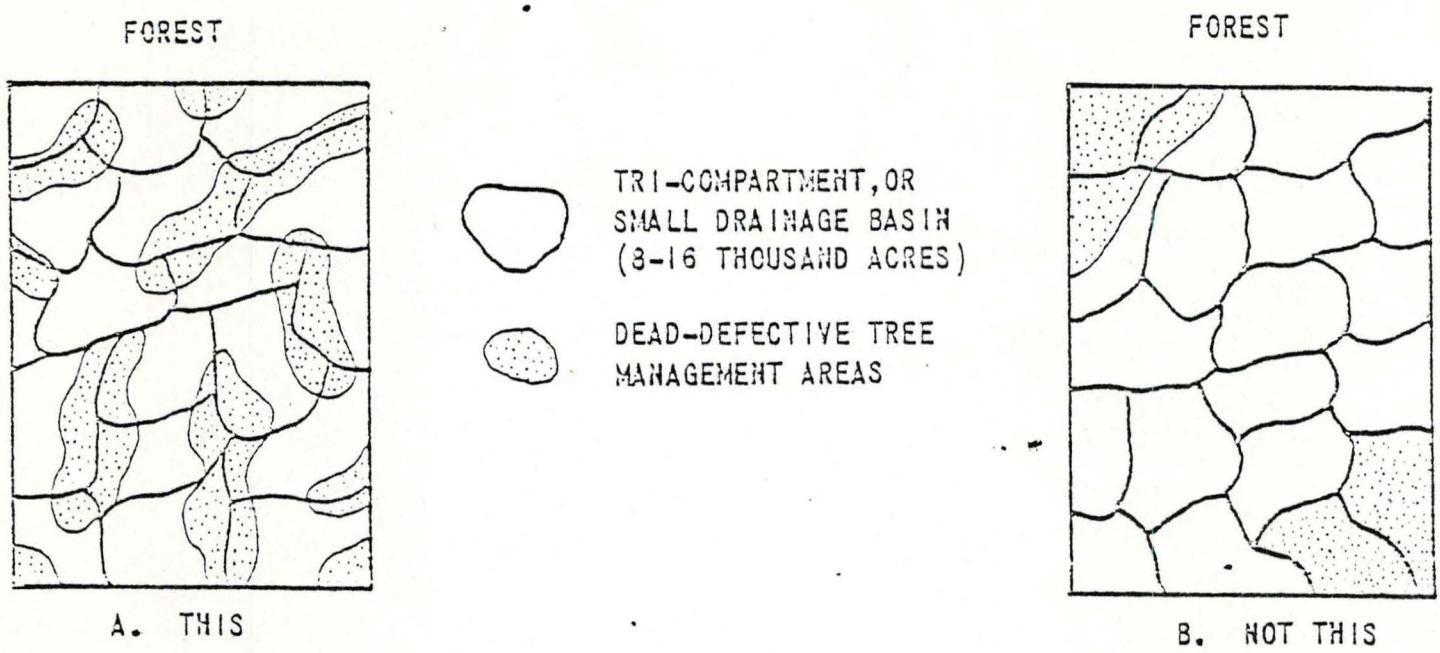


FIGURE 2

The minimum self-sustaining population is also calculated as is the number of dead and defective trees required to sustain that minimum level. The key factor is to disperse the needed number of dead and defective trees. If the special leave areas cannot provide the required number of dead and defective trees, then alternative methods must be explored. This situation may require the creation of snags in areas of clearcut units where conflicts with safety requirements, logging systems, and silvicultural practices are at a minimum.

In no way is this to be construed that no value is attached to one or a few dead or defective trees in isolated locations.

Section 8. DISTRIBUTION AND SIZE OF AREAS MANAGED FOR DEAD AND DEFECTIVE TREES

The preceding section provides guidelines to determine the minimum area needed to maintain self-sustaining populations. This section addresses dispersal and distribution patterns throughout the Forest. The combination of number of trees and their distribution is a vital component for successful management. Ideally, an even distribution would provide:

A. Genetic exchange between various population units of cavity nesters.

B. Ensure most of the Forest receives some degree of insect control by cavity nesting birds (Nearly all are insectivorous).

C. Maintain species diversity throughout the Forest.

The number of species, as well as numbers of a species, found in an area is related to the size of the area. There will be fewer species in a one-acre block of habitat than in a 50-acre block of the same habitat type. Habitat blocks of 40 acres to 60 acres appear to be the optimal size for managing dead and defective trees and for maximizing the diversity of excavators in western Washington.

GUIDELINE: MANAGE DEAD AND DEFECTIVE TREES FOR EXCAVATOR SPECIES IN BLOCKS OF AT LEAST 40 ACRES WITH THESE BLOCKS HAVING A RELATIVELY EVEN DISTRIBUTION.

This management direction does not mean that 40-acre tracts are set aside for management of dead and defective trees. It does mean that dead and defective trees should be scattered throughout 40-acre equivalents which will provide contiguous but dispersed patterns, as illustrated in Figures 2A and 2B.

Streamside Management Units, riparian zones, older Forest communities, headwall leave areas, and other special areas will normally contain dead and defective trees and provide a degree of dispersal on some commercial Forest lands, particularly along stream courses.

TRI compartments or small drainages are excellent reference points to illustrate desired dispersal. Calculations based on the total forested acres in a TRI compartment will indicate the maximum population of excavators those acres could support.

Section 9. WHERE TO MANAGE FOR DEAD AND DEFECTIVE TREES

This section addresses management of dead and defective trees for excavators in conjunction with the current timber harvest methodology of clearcutting and subsequent silvicultural practices for regeneration and intensive long-range timber management.

Dead and defective trees are distributed evenly, randomly, or in clumps, in natural forest stands. Generally, an even distribution of dead or defective trees provides the most habitat for excavators because each species is territorial.

A. CLEARCUT UNITS. Dead and defective trees in clearcut units are required by species such as purple martins and Western bluebirds. In addition, these trees provide hunting perches for hawks and owls, which feed heavily on rodents. Rodents feed heavily on conifer tree seeds and young conifers.

   Although preferred, an even distribution of snags in clearcut units would be difficult to achieve. A significant amount of interference with logging systems, herbicide application, slash burning, and safety requirements would occur.

GUIDELINE: IN CLEARCUTS, MANAGE FOR DEAD OR DEFECTIVE TREES IN SCATTERED GROUPS OR CLUMPS.

Generally, trees left in the interior of a clearcut have the least chance of spreading fire to adjacent stands when the unit is burned. Logging cable roads are widest on the lower portion of a unit. Fewer cable roads would have to be restrung to avoid clumps of leave trees. Suspension (deflection) is generally greatest on the lower portion of the slope. In this interior position, leave trees would receive the least damage and provide the least interference with logs being hauled to the landing.

GUIDELINE: MANAGE FOR DEAD AND DEFECTIVE TREES IN CLEARCUTS WITHIN THE FOLLOWING BOUNDARIES: ONE-HALF SLOPE DISTANCE FROM THE TOP EDGE OF THE UNIT AND 100 FEET FROM THE SIDES OF THE UNIT (FIGURE 3).

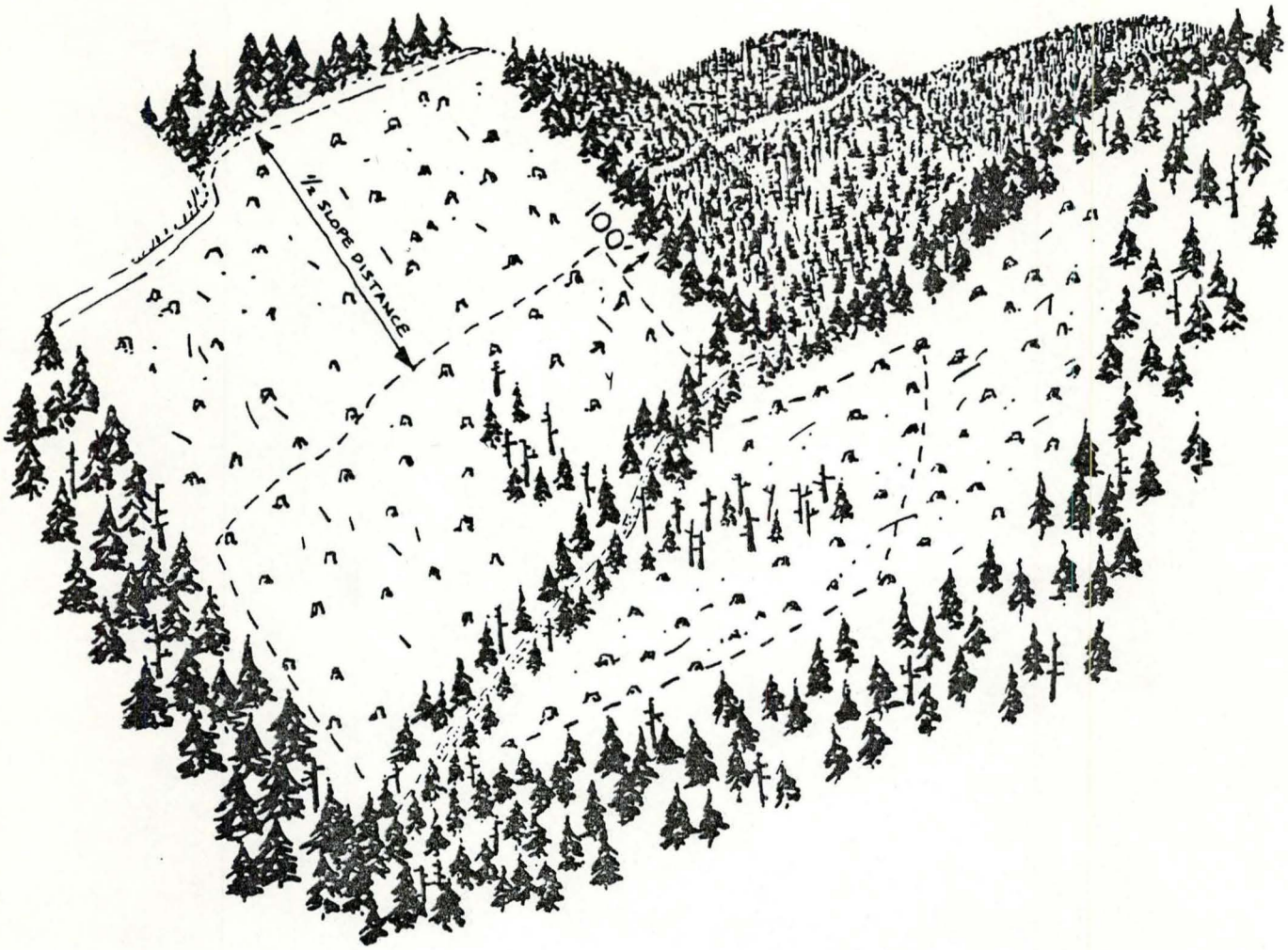


FIGURE 3

Live trees with defects can be left between (on the boundaries of) clearcut units, especially on the lower one-half of the slope (Figure 4). These trees should minimize interference with logging systems and cause no significant hazard when the unit is burned.

GUIDELINE: MANAGE FOR TREES WITH DEFECTS BETWEEN BOUNDARIES OF CUTTING UNITS ON THE LOWER ONE-HALF OF THE SLOPE (FIGURE 4).

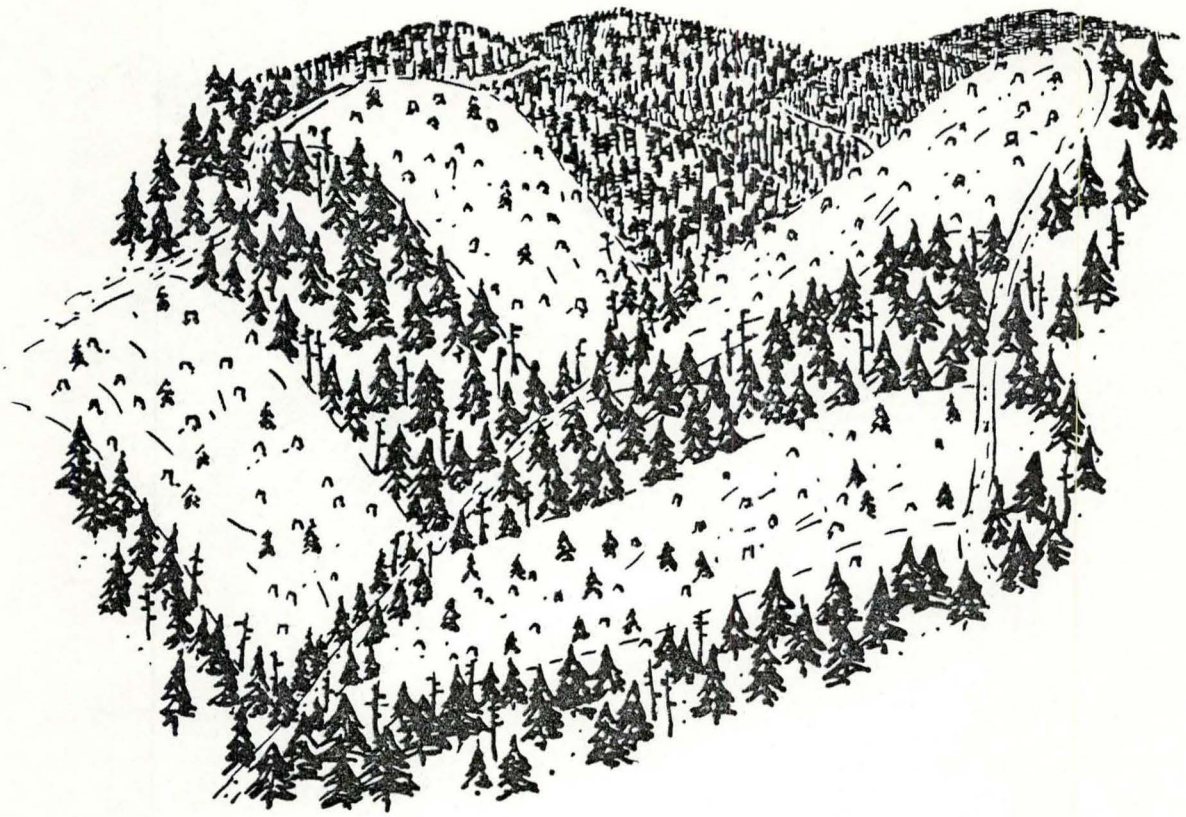


FIGURE 4

Current contract language allows for the removal of dead trees within 200 feet slope distance from the clearcut boundary. Large acreages adjacent to clearcut (edges) are becoming devoid of these wildlife trees.

GUIDELINE: MANAGE FOR SELECTED DEAD OR DEFECTIVE TREES THAT ARE MORE THAN 50 FEET SLOPE DISTANCE FROM THE EDGE OF THE CLEARCUT UNIT AND HAVE LITTLE PROBABILITY OF FALLING INTO THE UNIT OR CATCHING FIRE WHEN THE SLASH IS BURNED.

B. PARTIAL CUTS (COMMERCIAL THINNING, SALVAGE, SHELTERWOOD).

An even distribution of dead and defective trees would be much easier to achieve in partial cut units. The partial removal of trees from a forest stand requires finesse to insure remaining commercial trees or reproduction receive minimum injury. This finesse can be used to retain dead and defective trees in most partial cut operations. Since slash burning is limited in partial cuts, no significant fire hazard is expected from standing snags.

GUIDELINE: MANAGE FOR AN EVEN DISTRIBUTION OF DEAD AND DEFECTIVE TREES IN MOST AREAS WITHIN PARTIAL CUTS.

C. ADJACENT TO WATER COURSES, BODIES OF WATER, OR FOREST OPENINGS.

Dead and defective trees adjacent to streams, lakes, ponds, marshes, meadows or grasslands, are of extreme importance to wildlife. These trees are significant components of the "edge" between major habitat types. Edges usually support a greater diversity of wildlife species, and often a greater abundance than either of the surrounding habitats. Other resource values, e.g., fish habitat, water quality, visual, and dispersed recreation, are also of prime importance in these zones.

Many streams are buffered with vegetation. Logs are usually fully suspended over most streams. Trees left in these areas should not significantly interfere with logging systems. Damp conditions reduce the risk of a significant fire hazard. Cutting units can also be laid out to avoid vegetation adjacent to lakes, ponds, marshes, streams, meadows, or grasslands.

GUIDELINE: MANAGE FOR AN ABUNDANCE OF DEAD AND DEFECTIVE TREES WITHIN THE FLOOD PLAINS OF STREAMS AND WITHIN 3 CHAINS FROM LAKES, PONDS, MARSHES, MEADOWS, AND GRASSLANDS.

D. ROADS: About 2 to 6 miles of road per square mile will be needed to harvest and manage timber stands. Current contract language allows the removal of dead trees within 200 feet slope distance from roads. A significant acreage, about 56 acres per mile of road, could be made devoid of these wildlife trees.

GUIDELINE: MANAGE FOR ANY DEAD OR DEFECTIVE LIVE TREE WITHIN 200 FEET SLOPE DISTANCE FROM A ROAD IF IT HAS LITTLE PROBABILITY OF FALLING INTO THE ROAD.

E. HELICOPTER HOVERFILLS. Helicopter are heavily used in forest management for firefighting. Numerous hoverfills have been identified on the Forest. Dead trees adjacent to hoverfills ponds or lakes, are a potential safety hazard. These trees are also extremely important to wildlife (edge), especially those above the tree canopy. Hoverfills at small lakes or ponds could eliminate all dead trees above the tree canopy around the entire water area.

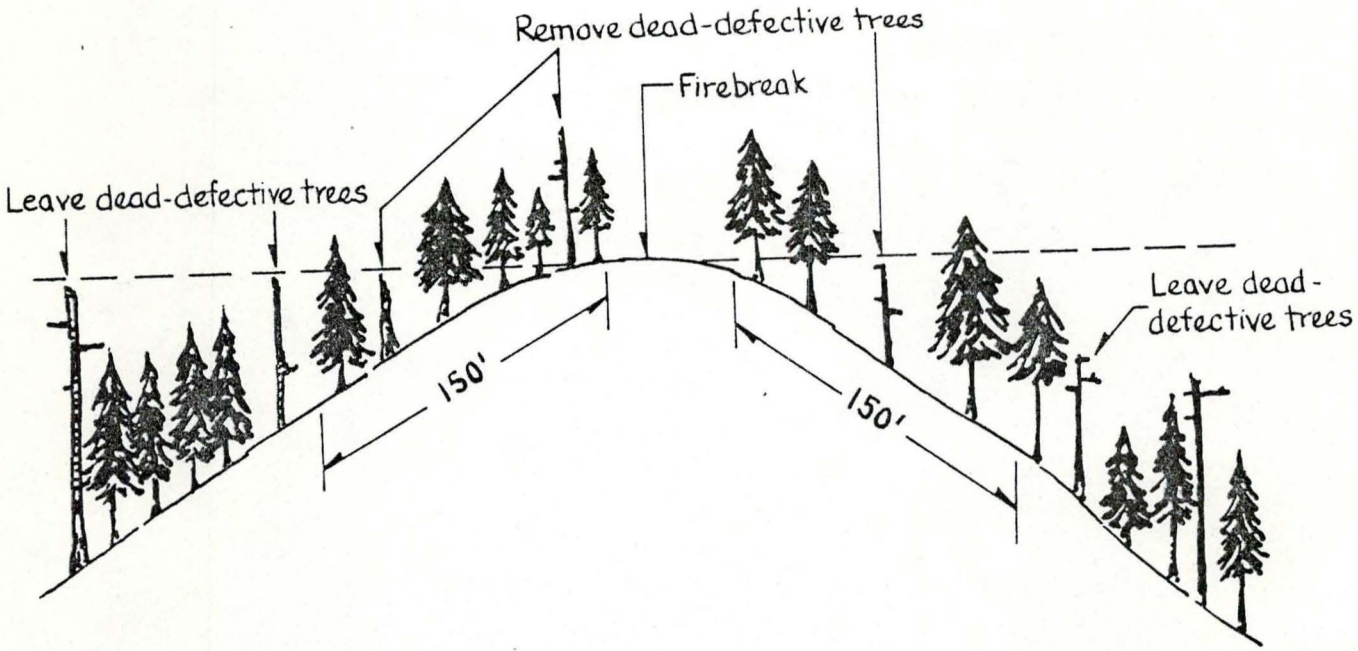
GUIDELINE: ALLOCATE SMALL LAKES OR PONDS BETWEEN WILDLIFE AND HOVERFILL SITES.

GUIDELINE: MANAGE FOR ANY DEAD TREE THAT DOES NOT EXTEND ABOVE THE TREE CANOPY WITHIN THE PRIMARY FLIGHT PATH TO AND FROM HOVERFILLS AT LARGE LAKES OR PONDS.

F. FIREBREAKS: Firebreaks designated by pre-attack planning involve a corridor, often a road, cleared of major fuels. Standing dead trees with 200 - 300 foot slope distance from firebreaks are reduced in number. Firebreaks remove dead and defective trees from a significant area of the Forest.

GUIDELINE: MANAGE FOR ANY DEAD TREE THAT IS 150 FEET FROM THE FIREBREAK CORRIDOR AND IS UNDER THE TREE CANOPY, OR ABOVE THE TREE CANOPY BUT NOT ABOVE THE GROUND LEVEL OF THE CORRIDOR.

FIGURE 5



APPENDIX II

DEAD AND DOWN TREES

The guidelines in this section deal with the management, numbers, kinds and distribution of dead and down trees needed by wildlife species. Down trees are extremely important as escape cover and den sites for small mammals. Woodpeckers use them heavily for feeding. Black bear often hibernate or seek insect larvae in down trees. Ruffed grouse require drumming logs for successful courtship. The above examples represent only a few of the roles dead and down tree habitat protray in the Forest ecosystem.

The current logging practice of yarding unmerchantable material (YUM) from clearcut units will reduce the number of dead and down trees available for wildlife use. Care should be taken to retain at least some of the larger diameter trees within these areas for wildlife.

Section 1. NUMBER, SIZE AND DISTRIBUTION

The number, size and distribution of dead and down trees available to wildlife species that utilize them are important habitat considerations. Generally speaking, the larger size classes (12" dbh or greater) of dead and down trees receive the greatest use by wildlife. Dead and down trees without limbs and bark are preferred by woodpeckers. An even distribution of dead and down trees provide wildlife with the greatest opportunities for feeding, cover, denning, etc.

GUIDELINE: AT A MINIMUM, MANAGE FOR TWO DEAD AND DOWN TREES WITH A DBH OF 12" OR GREATER AND CONTAINING 40 OR MORE CUBIC FEET PER ACRE. NOTE: THE TREES SHOULD BE LOCATED ON THE SAME ACRES AS STANDING DEAD AND DEFECTIVE TREE HABITAT AREAS.

Section 2. KINDS OF DEAD AND DOWN TREES

GUIDELINE: IN STANDS DOMINATED BY CONIFERS, SELECT CONIFERS FOR RETENTION.

GUIDELINE: IN STANDS DOMINATED BY DECIDUOUS TREES, SELECT SOME CONIFERS (IF PRESENT) AND A MAJORITY OF DECIDUOUS TREES FOR RETENTION.

APPENDIX III

Interdisciplinary Team Members

Area VI Snag Management Guidelines

TEAM MEMBERS

Jack Newman, Fire and Fuels Management, Mt. Hood
Dick Hammond, Landscape Architect, Gifford Pinchot
Tom Turpin, Silviculturist, Siuslaw
Bruce Smith, Logging Systems, Willamette
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Ray Scharpf, Biologist/Resource Assistant, Packwood Ranger District
Gifford Pinchot
Gene Silovsky, Biologist, Siuslaw
Keith Guenther, Biologist, R.O.
Kirk Horn, Biologist, Mt. Hood
Ed Harshman, Ranger and WIldlife Specialist, Willamette.

APPENDIX IV

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